PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to a Method of and Means for Effecting the Precipitation and/or Crystallisation of Solids in Solution, particularly in the Softening of Water

We, L'AUXILIAIRE DES CHEMINS DE FER ET DE L'INDUSTRIE, a Company organised and existing under the laws of the French Republic, of 117, Quai Jules Guesde, Vitry-sur-Seine, France, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to methods of and means for effecting the precipitation and/or crystallisation of solid substances dispersed or dissolved in a liquid medium, more especially in the softening of water.

It is well known that the speed of a physical or chemical transformation effected in a liquid medium can be materially increased as the stage of final equilibrium is approached (that is, the stage where an insoluble precipitate or crystals is or are formed) by introducing into the dispersion or solution a certain quantity of the solid to be precipitated or crystallised, in the form of particles thereof, which serve as nuclei to promote or accelerate the precipitation or crystallisation of the dispersed or dissolved solid in the liquid medium. Such expedient is frequently referred to as "seeding."

By this means, for example, the supersaturation of a concentrated solution of sodium sulphate which would normally remain supersaturated for a considerable time, can be effectively desaturated by introducing some crystals of the dissolved salt into the solution. Likewise gelatinous alumina produced by interaction of solutions of an aluminium salt and an alkaline carbonate can be coagulated in a few seconds, following upon the bringing of the two solutions together, if there is first introduced into one of the solutions a certain quantity of gelatinous alumina whereas otherwise the reaction would take one or two hours. In a similar way, in the formation and precipitation of calcium carbonate by interaction of dilute solutions of lime and calcium bicarbonate, the precipitation can be caused to take place immediately if the reaction be effected in the presence of some crystals of calcium carbonate, whereas in the absence of such crystals the precipitation would take several hours.

Furthermore, if the substance to be precipitated is one which is capable of assuming several different crystalline forms and some crystals of one of these forms have been first introduced into the solution, the dissolved solid will in crystallising out adopt the form of these crystals and deposit itself upon them, with the result that the crystals introduced will develop and progressively increase in size as crystallisation proceeds. Such action, of the newborn precipitate tending to attach itself to and build itself up upon any crystals of the dissolved solid initially present in the solution, is not limited to cases where the solid is capable of assuming several different crystalline forms; it frequently occurs in other cases, where the dissolved solid is capable of assuming only one crystalline form, and the general effect is for the mass of seeding crystals, if stationary as the precipitation proceeds, to become compacted, due to their growth in size, and very soon to set into a cemented mass largely if not entirely impermeable to passage of the liquid medium of the solution through it. Thus, if hard water to which a quantity of lime water has been added is brought into contact with a bed of calcium carbonate crystals, the crystals of the bed will rapidly enlarge until the whole mass has set to a form in which it presents an effective barrier to the passage of the water through it.

It is, therefore, necessary in effecting a physico-chemical action with the use of a mass of seeding particles which tend to set into a solid mass in the manner indicated, to maintain the particles in a state of agitation.

Various methods have been proposed, based upon this general conception to

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maintain the seeding particles in a state of agitation and the present invention represents an improvement upon the known methods, having for its object to enhance the effect of the agitation in ensuring the avoidance of consolidation of the mass of seeding particles in the manner described above.

According to the invention, a method of precipitating and/or crystallising a solid substance dispersed or dissolved in a liquid medium, more particularly in the softening of water, the dispersion or solution being percolated through a generally static mass of nuclei particles serving as seeding media to promote the precipitation or crystallisation action, with maintenance of the particles in a state of agitation to prevent their consolidation, is characterised by the fact that the form of agitation employed is a rapid vibration of the individual particles, imparted thereto by means acting independently of the flow of liquid medium percolating through the mass.

By "generally static" is meant for the purposes of this specification that the mass of particles is as a whole stationary in the vessel in which the precipitation or crystallisation is taking place, although there may be a migration (by gravity) of the larger particles towards the lower layers of the mass in a manner hereinafter more fully described.

The vibration may be communicated to the mass of particles directly or it may be transmitted to them through the intermediary of the surrounding liquid, or again it may be transmitted through the intermediary of the walls of the receptacle containing the particles. It may be produced by mechanical, electrical or hydraulic action.

By employing a vibratory movement to prevent a mass of nuclei particles from consolidating, the following advantages are obtained as compared with other processes:—

1. The effect produced on the mass is not dependent upon the rate at which the liquid flows through the filtering mass. Consequently, an installation in which the invention is incorporated can operate at largely varying outputs.

2. The automatic grading of the nuclei particles according to their size, with the larger particles collecting at the bottom of the layer, so permitting of a regular and selective removal of the larger particles when their dimensions have attained to a magnitude requiring their removal, takes place in an exceedingly efficient manner as compared with the use of other forms of agitation of the particles.

3. Similarly the anti-consolidation effect tends to be higher than with other forms of agitation, with the result that a more efficient distribution of the liquid throughout the mass of nuclei particles tends to obtain.

One method of carrying the invention into effect and a suitable form of apparatus therefor will now be described with reference to the accompanying drawing, by way of example, as applied to the softening of hard water by means of lime, the water to be softened and a stream of lime water being brought into admixture with one another within a mass of calcium carbonate crystals to which is imparted as regards each crystal a vibratory movement. The direction of circulation of the liquids through the mass of vibrating crystals may be as desired. In the particular embodiment of the invention now being described, it is downward, as will be seen from the following description of the apparatus referred to above:—

Referring to the drawing, the water to be softened and the lime water are fed respectively through a pipe 1 and a perforated ring 2 disposed in the upper portion of a mass 7 of particles of marble contained in a cylindrical receptacle 3 having a conical lower end portion 3a and a domed upper end portion 3b. The softened water is discharged from the lower part of the receptacle, at a level just above the top of the conical lower end portion 3a thereof, by way of a perforated ring 4. The particles of marble of the mass 7 thereof have vibratory movement imparted to them by means of a vibrator 5 and under these conditions the calcium carbonate which is formed by the reaction is almost instantly deposited on the surface of the particles of marble, the water leaving by way of the ring 4 perfectly clear. It is found that the reaction is complete, since the treated water does not become cloudy on standing.

During the process the particles of marble gradually increase in size without, however, compacting together to form a solid mass and as they increase in size they continually classify or grade themselves in the mass depthwise thereof, the larger particles collecting towards the bottom of the mass and occupying, therefore, the conical lower end portion 3a of the receptacle. When the total volume of the mass of particles in the receptacle has increased beyond a certain value, the larger particles are removed from the mass through a valve 6 at the bottom of the conical end portion 3a.

It is found that with the use of the improved method and apparatus of this invention, the hardness of hard water may be effectually reduced within a

passage time (i.e. the time taken to pass through the receptacle from the inlet 1 thereof to the outlet 4) of a few minutes only. The same water would need a treating time of several hours in the absence of a mass of nuclei particles maintained in vibration in accordance with the improved method of the invention.

By way of indicating the necessary proportions of the apparatus and rates of feed of water to be softened and lime water thereto, it may be remarked that if it is desired to treat water of 22 French degrees of hardness (1 French degree of hardness corresponds to 10 milligrams of $CaCO_3$ per litre), which is approximately equal to 15 English degrees, for the purpose of reducing its hardness to 5 French degrees (approximately 3.5 English degrees), with an output of 10 cubic meters of water per hour, a receptacle may be provided having a total capacity of 800 litres, through which there would be passed saturated lime water at a rate of 950 litres per hour. The receptacle is filled with calcium carbonate particles to the extent of 300 litres, the major dimension of any particular particle being from 1 to 3 mm. When the total volume of particles in the receptacle increases to 450 litres, a certain amount of the larger particles are removed through the valve 6, the amount removed being sufficient to reduce the volume to 300 litres.

The vibrator which is used in the method and apparatus of this invention may be any suitable vibrator for the purposes of the invention. Conveniently, it may be an electrical alternating current vibrator vibrating at the usual frequency of the electricity supply mains and transmitting its vibrations to the nuclei particles in the receptacle in which the precipitation and/or crystallisation operation is being performed, partly through the wall of the receptacle, to which the vibrations are conveyed through the intermediary of an arm connecting the vibrator to the wall.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A method of precipitating and/or crystallising a solid substance dispersed or dissolved in a liquid medium, the dispersion or solution being percolated through a generally static mass of nuclei particles serving as seeding media to promote the precipitation or crystallisation action, with maintenance of the particles in a state of agitation to prevent their consolidation, characterised by the fact that the form of agitation employed is a rapid vibration of the individual particles, imparted thereto by means acting independently of the flow of liquid medium percolating through the mass.

2. A method of softening hard water which consists in percolating it in admixture with milk of lime through a generally static mass of nuclei particles consisting of calcium carbonate and serving as seeding media to promote the water softening reaction, said particles being maintained in a state of rapid vibration imparted to them by means acting independently of the flow of water through the mass, so as to prevent their consolidation.

3. An apparatus for carrying into effect the method claimed in Claim 1 or Claim 2 which comprises a receptacle for the reception of a mass of nuclei particles as referred to in said Claims, an inlet or inlets thereto for the liquid or liquids to be treated, an outlet for the treated liquid and a vibrator operable to impart rapid vibration to the individual particles of the mass of nuclei particles in the receptacle during the percolation of the liquid or mixture of liquids therethrough.

4. An apparatus as claimed in Claim 3, wherein the vibrator is an electrical alternating current vibrator disposed within the receptacle.

5. An apparatus as claimed in Claim 44, wherein the vibrator communicates its vibrations to the nuclei particles partly through the wall of the receptacle, being connected thereto by an arm through the intermediary of which the vibrations are communicated to the wall.

6. A method of precipitating and/or crystallising a solid substance dispersed or dissolved in a liquid medium substantially as hereinbefore described.

7. A method of softening hard water substantially as hereinbefore described.

8. An apparatus for precipitating and/or crystallising solid substances dispersed or dissolved in liquid media, substantially as hereinbefore described with reference to the accompanying drawing.

Dated this 8th day of August, 1945.

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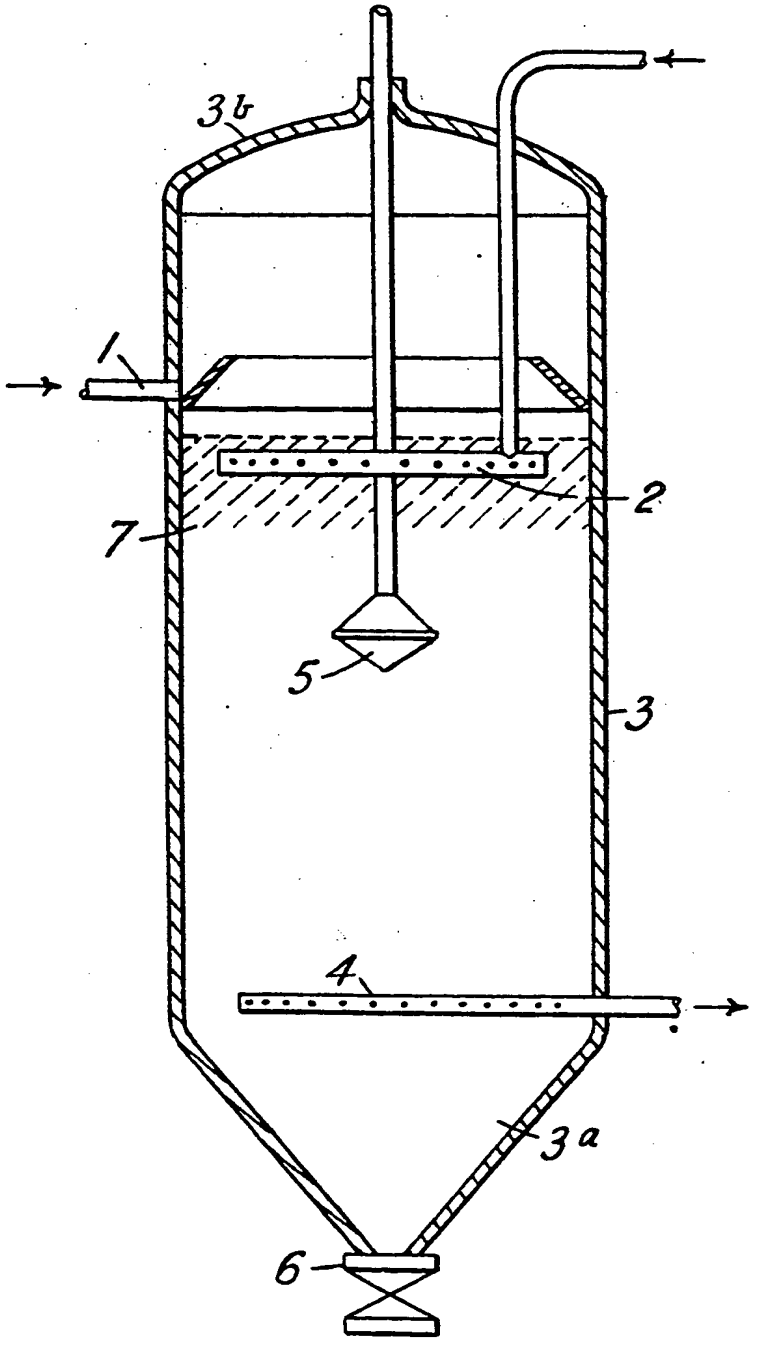

[This Drawing is a reproduction of the Original on a reduced scale.]

H.M.S.O. (Ty. P.)